Errors in judging 'offside' in football: Optical trickery can undermine the assistant referee's view of this ruling

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Optical trickery can undermine the assistant referee's view of this ruling.

In football (soccer), a player is 'offside' if he or she is closer to the goal than the last defender (excluding the goalkeeper) when the ball is passed to them. We investigated why assistant referees, who have the responsibility of judging offside, regularly make mistakes. We show that this is probably due to the angle of viewing by the assistant referee, who is frequently positioned beyond the last defender — a viewpoint from which errors are optically inevitable.

In a field experiment, three professional assistant referees (ARs, also known as linesmen) judged 200 potential offside situations played by two élite youth football teams (Fig. 1a). The ARs made 40 errors. One explanation for these errors is that the AR cannot see passer and receiver simultaneously: this causes the AR to shift his gaze from passer to receiver and so make judgements a split-second after the moment of passing — long enough for the receiver to have gone past the last defender and to appear offside[1]. We found, however, that this is an unlikely explanation for these errors, because an AR equipped with a head-mounted camera showed no shift of gaze from passer to receiver.

In 179 situations, the assistant referee was positioned beyond the last defender (mean, 1.18 m; s.d. = 0.94). In Fig. 1b, the 'outside' attacker is not offside. However, when attacker and defender are projected onto the AR's retina, the image of the attacker is just to the right of that of the defender. This means that the attacker is perceived as being in front of the defender, prompting the AR to wrongly raise his flag to call offside (flag error, FE). By contrast, in Fig. 1c the outside attacker is offside. But the AR will perceive attacker and defender as being in line, and so keep his flag down (no-flag error, NFE).

If these ideas are correct, then, when the attacker goes outside the defender (Fig. 1b), more FEs than NFEs should occur when the players are on the far side of the pitch from the AR, whereas the converse would be expected to occur when they are close to the AR (Fig. 1). In contrast, when the attacker goes inside, more NFEs than FEs should occur far from the AR, and more FEs than NFEs should occur near the AR. This also holds for judging offside in the middle zone (Fig. 1c): when the attacker goes right, NFEs are expected, and when left, FEs.

Data from our experiments (first row of Table 1), and from 200 videotaped football matches from five national competitions (1996–98 seasons) and the 1998 World Cup (Table 1) confirmed these expectations. In situations far from the AR, more FEs than NFEs were made when the attacker went outside the defender. In situations near the AR, more NFEs were made. If the attacker went past the defender on the inside, the opposite occurred. In the middle zone, there were 48 NFEs and 18 FEs when the attacker went right, and 61 FEs and 18 NFEs when they went left ($\chi^2 = 36.17$, $P < 0.0001$).

In conclusion, errors made by ARs in judging offside may often be the result of the relative optical projections of the players on the AR's retina. This means that, regardless of the quality of the AR, judgement errors are inevitable owing to the apparent limitations of our perceptual system. In our results, 9.3% of the AR's calls of offside were FEs. Given the high stakes in modern football, this incidence of (inevitable) errors suggests that alternative ways of judging offside should be developed, such as off-line analysis of video images taken from an adequate observation point.

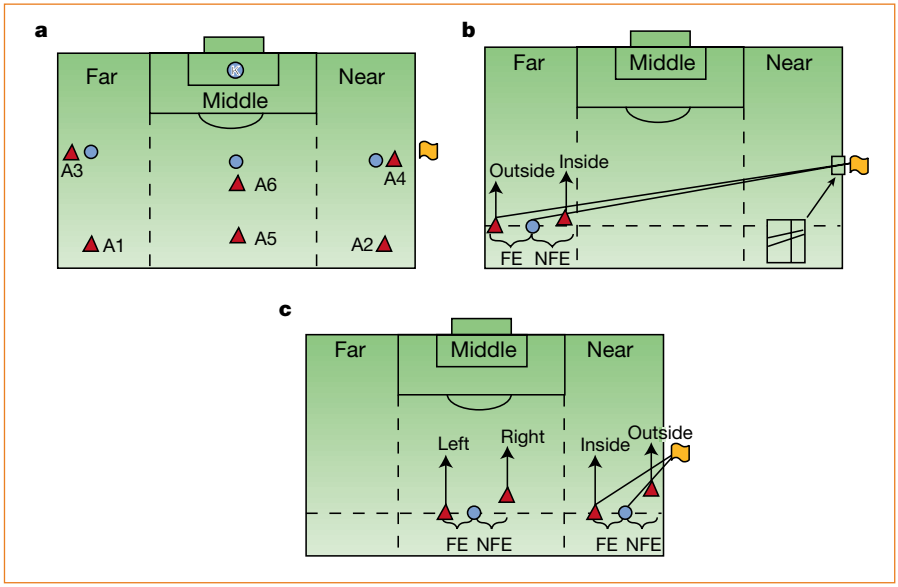

Figure 1 Offside situations. **a,** Experimental set-up of players in simulated offside situations. Attackers are triangles, circles are defenders (K is the goalkeeper, also known as the netminder), and the flag at the sideline depicts the position of the assistant referee (AR). Situations were videotaped with two cameras from an apartment block next to the pitch, so that we could determine whether the AR had judged the situation correctly. One AR wore a lightweight, head-mounted video camera to record his head movements relative to the scene. Experimental details are available from the authors. **b,c,** How the AR would perceive the relative positions of attacker and defender in far situations (**b**), and in situations near the AR and in the middle of the field (**c**). FE (flag error) and NFE (no-flag error) show the kinds of error expected in each situation.

Table 1 Frequencies of flag errors and no-flag errors

	League	Games	Far from AR		Near AR		χ^2	P
			FE	NFE	FE	NFE		
Attacker goes	Experimental		23	5	3	9	12.06	< 0.001
'outside'	Spain	50	43	7	6	19	28.29	< 0.0001
	The Netherlands	50	40	6	4	21	34.60	< 0.0001
	Italy	25	15	4	1	9	12.59	< 0.0005
	England	25	16	4	1	10	14.41	< 0.0005
	Germany	25	19	3	2	10	15.97	< 0.0001
	World Cup '98	25	15	2	2	6	10.00	< 0.005
Total			171	31	19	84	127.30	< 0.0001
Total 'inside'		200	21	43	34	16	13.92	< 0.0005

The inter-observer agreement for the analysed matches, computed on the basis of a selection of 12 matches watched by a second observer, was 93% (142 out of 152) for all potential offside situations and 90% (27 out of 30) for errors made by the ARs.

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1. Sanabria, J. *et al. Lancet* **351,** 268 (1998).